be expected that it would pass a vote morally condemning its own acts. In the next place, the opposition, or, more properly speaking, the true friends of education in New York, began their attack by first selecting a candidate whose reputation, experience, and force of character were not equal to the tremendous work of reforming the present vicious system of instruction. The large results of the investigation of Mr. Jasper's records will appear next year, when he will be confronted by a rival candidate as well as his own record. The public has now been informed of the sad situation, and will be prepared for serious work when the next two years close and another election of superintendent takes place. When Mr. Kiddle withdrew, and Mr. Jasper took the New York schools in hand, the change was noticed at once. The teachers were all put in the position of wheels contributing to a nicety to the general movement, and the product was a machine-made pupil. The perfect examination was very much on a par with Showman Forepaugh's trick-elephant. If one teacher undertook to feed the starved minds of the little ones, then there was trouble with the machine, and the teacher was subdued." Every word of this is true, and is in full accord with the position that *Science* has taken in this important matter. If the Public Education Society does its full duty, the situation will be materially altered before another election takes place.

THE LONDON PUBLISHERS and printers are getting more and more excited over the provision of the Chace international copyright bill, which requires a foreign book copyrighted in this country to be printed from types set up in the United States. The printing and allied trades section of the London Chamber of Commerce has sent a resolution to the Chamber of Commerce, asking the government to obtain by diplomatic means the withdrawal of the objectionable provision, and, if this is not done, demanding that a similar law be passed in England. What the English publishers and printers desire is an opportunity to make all books written or compiled in Great Britain and sold in the American markets. That is something that the Congress of the United States will never agree to, if the passage of an international copyright act is postponed a quarter of a century. England may prevent books printed in America from being sold in Great Britain, but will never succeed in dictating in what shape a law shall be passed by the Congress of the United States until the former raises a generation of abler diplomatists than she has lately sent abroad.

AN ITEM PUBLISHED in the Washington papers last Saturday, entitled 'The Army Ahead,' in which it is represented that competitive tests of the 'indications' work of the Signal Office, to determine the relative merits of military and civilian officers in the performance of this work, had been made, is likely to mislead any one who has not read the description of the present condition of affairs in the Signal Office, published in the last issue of *Science*. The predictions for February were made by Lieutenant Dunwoody, and those for March by Prof. Cleveland Abbe. The percentages of verifications for each month have been computed by Professor Marvin, who found the record as follows: Professor Abbe, indications 75.42 per cent, storm-signals 62.50 per cent, cold-wave signals 53.99 per cent; Lieutenant Dunwoody, indications 80.55 per cent, storm-signals 89.29 per cent, cold-wave signals 86.11 per cent. It should be remembered, that years ago, when the weather reports became most popular and there were nothing but compliments for its predictions, Professor Abbe, then in thorough practice, prepared the indications for a long time. Of late he has been engaged in an entirely different line of scientific work, and it was not to be expected that he would be as successful in preparing indications as an officer who had lately been engaged in that service. General Greely's purpose in putting Professor Abbe upon this duty at all was to train civilians for it in case Congress, as seemed more than probable, should transfer the weather bureau to a civil department.

THE CRENITIC HYPOTHESIS AND MOUNTAIN-BUILDING.

THE facts derived from the study of metamorphic rocks and volcanic phenomena make it evident that there are two types of motion which take place in the deeper-buried materials of the earth's crust. One of these classes of movements occurs when volcanic ejecta creep horizontally towards the vent, or when the materials which afford the support of mountain-arches undergo massive movements towards the base of such folds in the rocks. In these cases of horizontal movements we have translations of extensive bodies of matter for considerable distances. The other class of movements taking place in the crust are in a vertical direction. They are brought up in part by the action of water, and in part by the action of igneous forces. The operation of these agents leads to a very extensive transfer of material in a vertical path, from the deeper-buried to the more superficial strata. I propose in the following pages to consider the general effect of this upward movement of matter upon mountain-building.

The simple inspection of most mountain-built districts will show the observer that there has been a very extensive movement of materials from lower to higher levels in the crust in such areas. Taking a considerable surface of mountainous country, where by chance the bed-rocks are exposed to view, we almost always find in such regions numerous veins and dikes. Thus, in the anticlinal districts of New England, especially where those portions of the surface are exposed along the seashore, we are often able to ascertain, that, on the path traversed by a straight line a mile in length, the addition to the material in the more superficial rocks has been sufficient to produce a considerable extension of their area. In some sections having this length, I have been able to prove that the increase in the horizontal section, due to the introduction of the materials derived from below, amounts to as much as from ten to twenty per cent of the original area; or, in other words, on a line a mile in length, the dikes and veins occupy from one-tenth to one-fifth of the distance. Besides the distinct intrusions of matter in the form of dikes and veins, there have in many instances been large contributions to the more elevated parts of the crust through the interstitial contributions of crystalline material. Thus in some of our highly metamorphosed rocks, where the materials have assumed the crystalline structure, a progressive growth of the hornblendic and other aggregations has been observed; so that, besides the contributions of matter which we may reckon from a study of dikes and veins, there is often a large but incomputable element of crystalline growth, serving to extend the rocks, which is not readily to be taken into account.

The immediate causes of this transfer of material from the deeper-lying to the more superficial parts of the earth's crust are now tolerably well known. In large measure it is due to the peculiar effect of temperature upon the water which was enclosed in the sedimentary rocks at the time of their formation, or which may have penetrated into them from the surface. The process of burial beneath sedimentary formed accumulations acts in all cases to lift the temperature of all the rocks which are subjected to such covering. Where these rocks contain the waters of deposition, they are likely in time to be brought to a high degree of heat. The temperature to which they attain, and the pressure to which they are subjected, enable them to dissolve a large share of the materials with which they come in contact. Moving upward in the channels which may be opened by chance riftings of the superimposed strata, these waters, deprived of their power to retain the materials in solution by the loss of temperature in their upward journey, and the relinquishment of pressure which comes about at the same time, lay down deposits in the upper portions of the crust. In a similar manner the descending pluvial waters obtain in the deeper parts of the crust a store of dissolved materials, which, on their re-ascent, is likewise deposited in the higher rocks. Thus the movements of water below the drainage-level of the country inevitably operate to bring from below and deposit in the upper parts of the crust large amounts of mineral matter.

The nature of the forces which urge dike-stones from the deeper to the more elevated parts of the crust are not so clear as those involved in the formation of veins. It seems not unlikely that it is to

the expansive energy of the contained water that we owe, in part at least, the upward movement of such materials. It is clear that this is the case in true volcanic dikes, for all the phenomena of a volcano indicate that the mainspring of its movements is to be found in the vapor of water. The close likeness between ordinary volcanic dikes and those which we cannot assuredly connect with volcanoes leads us to the conclusion that all injections whatsoever are most likely due to expanding vapors. Be this as it may, the effects of dikes is to clearly remove the material from a great depth, and place it in more superficial rocks.

Although it is most likely that the crevices into which dikes find their way may occasionally owe their dislocations to the action of contraction attending on certain metamorphic changes, probably the greater part of such ruptures are due to strains connected with changes in the attitudes of the rocks. The dike material thus acts as wedges to fill in all the cavities accessible to the igneous rocks, as far as they are formed. It is evident, that, where this process is numerously repeated, a considerable horizontal extension of the rocks is necessarily brought about. Thus in many parts of New England, as is well shown along its extended shore-line, where the coast reveals the crystalline rocks, from one-tenth to one-twentieth of the superficial area is occupied by such dikes. Generally, where the conditions have been such as to induce an injection of dikes, there is a large amount of vein matter deposited in the same field which still further serves to produce an extension of area. Thus in the region about Eastport the gain in the superficial area due to these two causes amounts to somewhere near three per cent or five per cent of the superficies exposed on the present surface of the rock.

Let us suppose that within any area of the earth's surface the conditions are such as to favor, through the forces which lead to vein-building and those which operate to create dikes, the vertical migration of matter from considerable depths towards the surface. The result on the tensions in the crust at such a point will evidently be such as to favor the construction of mountains. The constant abstraction of material from the depths will lead to a diminution in the bulk of the deposits of that lower level, and a parallel augmentation of the strata nearer the surface. It may well be that the differential contraction of the earth's mass, being greater at lower levels than at higher altitudes in the section, may create a slight tendency to buckle into mountain-ridges in all parts of the crust: but, wherever this general contraction is combined with the crenitic action, we may expect to find a more complete development of mountain-chains; and such points will be the seats of folding, and they may by their wrinkles effect the necessary contraction of the crust, and thus prevent folding in other sections where the contraction of the whole sphere alone tends to produce wrinkling.

It seems to me that this hypothesis may, perhaps, explain the fact that regions which have long been the seat of active sedimentation naturally become the sites of mountain-building. James Hall and others have noted the fact, which so far has remained inexplicable, that the first stage in mountain-building consists in the production of extended sedimentary deposits of more than normal thickness. During the deposition of these sediments the earth's crust appears to be down-borne by their weight. After the subsidence some action sets up which leads finally to a certain elevation of the area, and consequently to a development of erosive action. As the deposits are worn away, the mountains rise higher and higher, as the folding becomes more and more intense.

Although the generalization concerning the formation of mountains which I have just stated has not been critically compared with the many instances of mountain-structure, it seems of sufficiently common occurrence to demand an explanation, and it very likely will prove true for all large mountain systems whatsoever. Is it not possible that we may account for the development of mountains through these series of changes in the following manner? viz., where, as along a shore-line, sediments are thickly accumulated, the first effect may well be the down-sinking of the region; then, as the thickness of the stratified section increases, and the blanket retaining the internal heat becomes deeper, the internal heat will be greatly increased in the lower portions of the section. This will induce an upward migration of the imprisoned waters, and consequently, in time, a transfer of material to higher levels in the rocks. The consequent expansion of these superjacent rocks will make them tend to buckle. The superficial strata may not have received any considerable infiltration or injection of the material, yet they may be contorted by movements in the subjacent rocks which have thus been increased in volume; in other words, an intensification of deposition, if the sediments attain a great depth, may in time lead to a reversal of the down-sinking movement and the construction of a mountain system in what was previously a basin of sedimentation.

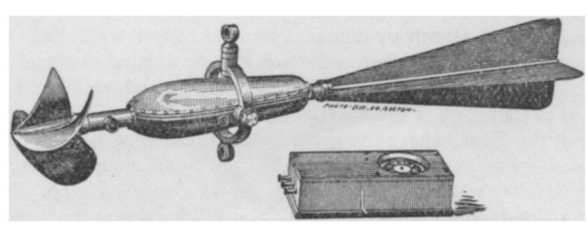
This explanation of mountain-folds will probably not at all account for the development of the basilar uplifts or tableland elevations which are developed in connection with all or almost all important chains. It may well be the fact that the expansion of the overlying deposits through the upward deportation of matter is only one element in determining the formation of mountains. It may in the end turn out that mountains are the result of a tolerably complicated series of causations, in which secular refrigeration of the earth, the transfer of weight by the operations of erosion and deposition, and the subterranean migrations of matter, all take a part. It may indeed well be the fact that these internal movements of material are due to more than one cause. I am, however, inclined to believe that to this vertical movement of materials we owe in many cases a share of the conditions which bring about the formation of mountainous dislocations. N. S. SHALER.

SCIENTIFIC NEWS IN WASHINGTON.

A New Instrument for measuring the Direction and Velocity of Submarine Currents. — Cabinets of Typical American Rocks, for Use in Colleges and Universities. — Beautiful Specimens of New Jersey Serpentine. — Ojibwa Pictographs in the West. — The Yellow-Fever has disappeared from Florida. — Interesting Phenomenon at Sea.

A Direction-Current Meter.

THE increasing commercial importance of our rivers and harbors, and the recent large annual appropriations for their improvement, have given a fresh impetus to the study of physical hydrography and hydraulics. It has come to be pretty generally recognized that no plans for the permanent improvement of tidal harbors, and such streams as the Mississippi and its tributaries, can be perfected without a thorough knowledge of the physical laws which underlie the complex phenomena they present. The investigation of these laws has stimulated observers and experimenters to the invention of many new and improved devices for the precise measurement of the various factors involved. One of the most interesting of these devices is a direction-current meter, recently perfected by Mr. E. S. Ritchie, the well-known maker of philosophical apparatus, of Boston, and Mr. E. E. Haskell of the United States Coast and Geodetic Survey. The characteristic feature of this meter is that it gives simultaneous measures of the direction and speed of a current. The direction is determined by means of a compass in all respects similar to Mr. Ritchie's trailing compass, which is mounted in an elongated chamber, whose axis coincides with the axis of the meter (see accompanying cut). A system of electro-magnets and



circuits connects the compass with a dial, which may be placed in any convenient position, in such a manner that the observer may make the dial indicate the same azimuth as the compass-needle. The speed of the current is measured by a conical propeller-wheel, whose flukes are curved in conformity with the requirements of theory for maximum rotary effect of moving water, and whose mass is as small as practicable with its requisite stability. The revolutions of the wheel are counted automatically by an electro-